Deutschland
Land der Ideen

CUTEC NEWS

FACTS · INFORMATION · ANALYSES

9th July 2007
Open day

No. 8 www.cutec.de August 2007

CUTEC: You are at an award-winning site

Presentation of the honorary plaque to Prof. Carlowitz (l.) by Mr. Eggert (Deutsche Bank)

Certainly you will have heard of the initiative "Germany – Land of Ideas" that was initiated last year on the occasion of the Football World Cup and met with a lively response in the media. This initiative is supported jointly and independently of party politics by German industry and commerce and the Federal Government; it is under the patronage of the Federal President Horst Köhler. One of the initiative's projects is the nationwide contest "365 Landmarks in the Land of Ideas", in which we took part last year. In November 2006, 365 winners were chosen from more than 1500 applicants. On each day of the year 2007, one of these locations receives an official award and presents itself to the public in an event. The 9th of July is our day: We will open our doors, and I would be pleased to be able to welcome you on this special day here in Clausthal. In the enclosed programme you can read the details of what awaits you. Those of you who have visited our website know that I already received the honorary plaque and the certificate with the Federal President's signature on 19th February from the hands of two representatives of the Deutsche Bank, the exclusive project partner of the initiative, in the course of a short ceremony (see photo on the left). We applied and won with a project from our special field of research "biomass conversion". Behind the slogan "Car driving with plant power – Clausthal Institute for Environmental Technologies develops the fuel of tomorrow" is our ArtFuel pilot plant. In this plant, about which we have already reported several times, various types of biomass are converted into energy-rich gas, which can be transformed into fuel or chemical raw materials in further process steps. With this project, we also presented ourselves to the public in mid-June in Braunschweig, the City of Science 2007, at the event "Wissen findet Stadt" (knowledge meets the city). The event was organized by the association "ForschungRegion Braunschweig e.V." (research region Braunschweig), of which CUTEC is a member, thereby expressing our attachment to the research region.

Here in Clausthal at CUTEC I would like to welcome the new head of the Department of Chemical Processes, Dr.-Ing. Andreas Lindermeir, who took over the department on 1st May and is introduced to you in a separate article.

Finally, please make a note of 9th July. I am looking forward to your visit, to the exiting discussions that will certainly take place, and I wish all of us an interesting open day at our premises.

Yours Otto Carlowitz

IN THIS ISSUE

- CUTEC is present on national and international trade fairs 2
- A new project: Nutrient recycling from waste water
  How to recover phosphorus and nitrogen (largely) without external energy input 3
- CUTEC at the "Forwind" symposium in Oldenburg 3
- Development of an RPC plant for exhaust gases with silicon-organic components 4
- Pure rapeseed oil: From the field straight into the diesel engine? 5
- New: Ergonomic workplace 5
- Waste management training for Nigerian delegation 6
- We congratulate … 6

Dpt. of Chemical Processes under new direction

Dr.-Ing. Andreas Lindermeir has worked at CUTEC since 1st May

Dr.-Ing. A. Lindermeir

Since 1st May, Dr.-Ing. Andreas Lindermeir has directed the CUTEC department "Chemical Processes". He succeeds Prof. Dr.-Ing. Michael Claußen, who died in 2006.

Dr. Lindermeir studied chemical engineering at Clausthal University of Technology (TUC) and completed his doctorate there on the topic "Zur Frage der industriellen Fertigung einer Direkt-Methanol-Brennstoffzelle: Eine ingenieurwissenschaftliche Betrachtung" (On the problem of the industrial production of a direct methanol fuel cell: An engineering approach).

From 2000 to 2003, he worked at the Institute of Chemical Process Engineering of the TUC, where he was instrumental in setting up the production of

Continued on page 2

CUTEC is present on national and international trade fairs

CUTEC stands always well attended – at the CeBIT, the Hannover Trade Fair and the Americana

CeBIT 2007

At this year's CeBIT, the Department of Modeling and Simulation was represented with an exhibit on the topic "humanitarian mine clearing". In addition to a metal detector test station, a software solution was on display that had been developed in the context of a project supported by the Federal Ministry of Education and Research. This solution allows CI methods not only to detect, but also to identify mines – regardless of mine depth and the geological conditions of the surrounding ground.

This breakthrough in the analysis of electronic signatures was made possible by the application of neural networks and of innovative signal processing methods which had been developed especially for the given task.

Prof. Dr. Matthias Reuter (r.) demonstrating the "mine software" developed at the institute, together with Secretary of State Dr. Lange from the Ministry for Science and Culture of Lower Saxony

In view of the problem that approximately 200 million buried mines worldwide are still a great risk for the population and the infrastructure, the response at the fair was correspondingly good. It was possible to greet top politicians at the stand, as well as numerous representatives of industry and trade who were interested in the "mine software".

It can be noted as a particularly positive response to the exhibit that, in addition to the director of the publishing company Report Verlag, whose specialist and executive magazines are constantly on display in the German parliament, high-ranking military representatives also asked the members of the Department of Modeling and Simulation at the stand to explain their research. (reu)

Americana 2007

At the Americana 2007 in Canada, CUTEC was also represented with a stand of its own. This North American trade fair for environmental technology takes place every other year, this year from 20th to 23rd March in Montreal. The Institute was represented by the CUTEC manager of international operations, Dr. T. Onyeche, and his assistant, Mrs. W. Weber.

In Canada, the field of environmental protection and technology is receiving increasing public attention. The interest in the technologies and processes presented by CUTEC was correspondingly great. This was reflected by the large number of guests at the stand and the intensive technical discussions.

It was not only guests from Canada and the USA who visited the exhibition, but also environmental experts from Europe, Africa and, above all, from South America.

The fair served as an opportunity to establish new, important contacts and to present the CUTEC technologies on the spot. (on/wb)

Hannover Trade Fair 2007

At one of the most important trade fairs in Europe, CUTEC presented itself on the communal stand of the Federal State of Lower Saxony with a production-ready product for "energy generation from renewable resources". The product is our patented fermentation test apparatus for the reproducible determination of the potential biogas yield from biomass fermentation. The instrument was developed at CUTEC in the period up to 2004 with the support of industrial partners and the AIF (we reported in CUTEC News 2/2004), and now, after a three-year testing phase, it is ready for marketing and service provision as a part of the CUTEC product range.

Both visitor numbers and the level of interest from experts and foreign guests in the gas-measuring technology were pleasingly high. The reactions ranged from "How much does it cost, and when can I get it?" up to discussions about the potential for cooperation with CUTEC in order to solve complex R&D tasks in the optimization of the energy yield from biomass. One of the numerous visitors who sought expert information was the Lower Saxon Minister for Science and Culture,

Dr. Schläfer (r.) explains the functional principle of the gas-measuring cell to Minister Stratmann (Lower Saxon Minister for Science and Culture)

Lutz Stratmann, who was welcomed at the CUTEC stand by Dr. Schläfer, who had been instrumental in the development of the gas-measuring cell. (schl)

Continuation from page 1

Dpt. of Chemical Processes under new direction

direct methanol fuel cells and in developing and operating them. Furthermore, he was active in the field of ultrasound-based electrosyntheses. In 2003, Dr. Lindermeir moved to the company Webasto AG in Neubrandenburg, where he worked in the fields of liquid fuel reformation and fuel cell system development in the context of an SOFC development project.

At CUTEC, he continues the previous activities for the development and optimization of conventional and new energy-efficient techniques for the production of fuels from carbonaceous resources such as biomass. Another focus of his work is the integrated study of fuel cell systems and their individual components in consideration of integrated heat and material management. In addition to that, auxiliary measures for the reduction of traffic-related emissions with an impact on the environment will continue to be studied, developed and optimized. (he/wes)

A new project: Nutrient recycling from waste water

How to recover phosphorus and nitrogen (largely) without external energy input

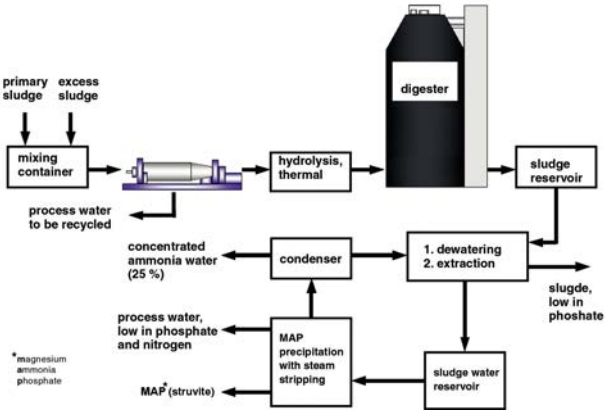
Just recently, the Deutsche Bundesstiftung Umwelt (German Federal Environment Foundation) has approved a new project on "process-integrated nutrient recycling from waste water". The nutrients nitrogen and phosphorus are at the focus of interest. But why should these particular nutrients be recovered? After all, nitrogen is available in abundance, and phosphorus is also thought to be available for another 100 to 400 years.

The starting point of the considerations is the increased production and utilization of biogas from sewage sludge. This objective fits in very well with the overall targets of the Renewable Energy Act, but it has the disadvantage that increasing methane yield results in higher concentrations of the nutrients nitrogen and phosphorus in the solution, which leads to an increasing and more cost-intensive load of the waste water treatment plant.

The purpose of the project that has just been approved is, in short, to "turn the disadvantages into advantages". In cooperation with the industrial partner Pollution Control System (P.C.S.) GmbH, Hamburg, a concept has been developed that will be analysed during the next two years. In this context, material flow and energy balances will be set up and evaluated economically. (see figure above)

Plant for thermal hydrolysis using the CAMBI process in Bydgoszcz, Poland

The first step will be concentration of the nutrient-containing sludge. Before this sludge is converted into biogas in the digester, thermal hydrolysis is conducted according to the CAMBI process. This hydrolysis is the state of the art, and with more than 10 operating plants – primarily abroad – it can be considered a proven technology (see figure below, example plant). It takes place at approximately 120 to 140 °C and not only results in a considerably faster methanation, but also in a significantly higher degree of decomposition of the organic substances. The latter causes the CAMBI process to operate self-sufficiently in terms of energy and to produce additional usable methane.



Technological approach to phosphorus and nitrogen recovery

The process-integrated nutrient recycling comprises, first of all, a precipitation of the phosphate dissolved in the sludge water. Subsequently, approximately 5 % of the available steam from the CAMBI process is used for ammonia stripping (ammonia removal from the sludge water). The precipitated phosphates as well as the ammonia water are marketable products, whose process-related quality characteristics are to be determined experimentally.

An innovative feature of the process is the utilization of some of the ammonia water as an extracting agent. Preliminary testsshowed that the recovery ratio for phosphorus can be approximately doubled by means of ammonia water extraction. The question arises as to whether this extension is technically and economically feasible. This will be analysed during tests on a small-scale plant.

Last, it should be stressed that this project is of vital importance for the Department of Physical and Biological Processes because the nutrient conditions can be transferred to biogas plants to a certain extent. (siev)

CUTEC at the "Forwind" symposium in Oldenburg

Energy supply in transition – Integration of renewable energies into tomorrow's electricity supply

In the field of renewable energies, numerous intelligent decentralized technologies are currently available. The next step is the efficient integration of these into existing structures in order to achieve the ambitious EU target of reaching a proportion of 10% of the total energy supply by 2010. This was the major topic of the international congress "Decentralised Energy Systems – Integrating Renewable Energy Technologies in Tomorrow's Energy Supply" that was held by the Center for Wind Energy Research (ForWind) in Oldenburg on 15th and 16th February.

CUTEC director Prof. Carlowitz and Prof. Beck, the vice president of Clausthal University of Technology (TUC), were invited to report on the current state of their research into the topics of biomass conversion and virtual power plants for energy supply. Together with their colleagues from science, industry and politics, they discussed technical innovations and roads to an energy supply system that meets the requirements of the future.

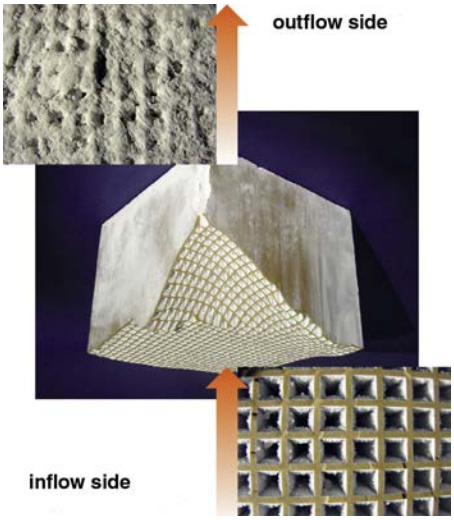
In the accompanying exhibition, CUTEC displayed its current projects "Artfuel" and, in cooperation with the TUC, the "Energy Park Clausthal". The response of the participants was very good; appointments for visits to CUTEC were already made during the event. (kra)

Photo: Ulrike Upmeyer, University Oldenburg

The Energy Park attracts visitors to Clausthal

Development of an RPC plant for exhaust gases with silicon-organic components

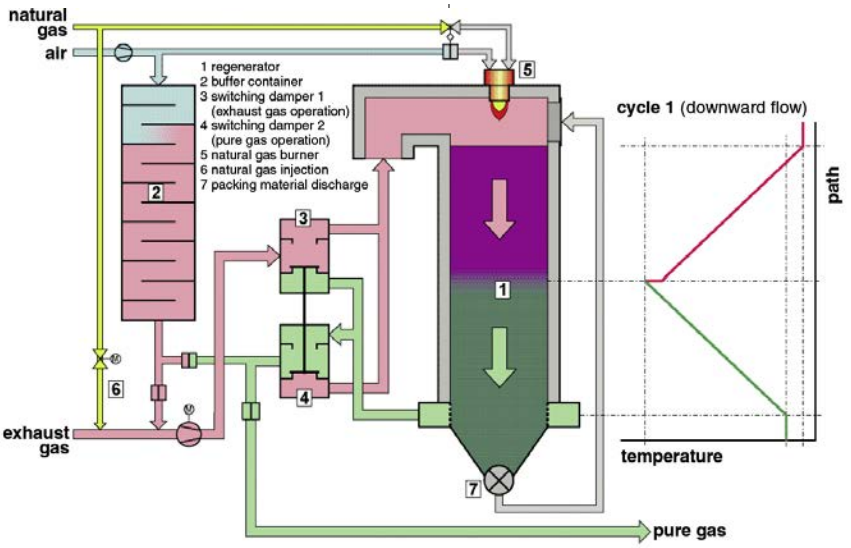
In several projects, the stationary exhaust gas purification working group is engaged in the optimization of thermal exhaust gas purification units with regenerative exhaust air preheating RPC (regenerative post-combustion) plants. The RPC technology has proved remarkably reliable in many applications in the processing industry and in waste management for the treatment of exhaust gases containing organic pollutants, and it is the most frequently applied technique at present. However, if the exhaust air contains silicon-organic components, massive problems arise for plant operation because the ceramic regenerator material that is used for heat transfer gets blocked up (see figure below). Since the use of silicon-organic compounds has



Silicon oxide deposits on the monoliths of an RPC unit

significantly increased in recent years, numerous operators in the fields of plastics processing and recycling, coating, siloxane and silane production, memory chip manufacturing, waste recycling MBT (mechanical-biological waste treatment plants) etc. are affected by this problem. In the context of the implementation of the 2002 amendment of the Technical Instructions on Air Quality, many of these operators are now faced with the requirement of using an exhaust gas purification unit for the first time. According to the state-of-the-art, they would have to fall back, for example, on a conventional TPC (thermal post-combustion) plant with all the associated ecological and economical disadvantages – very high fuel consumption and increased CO_2 emission.

Previous efforts to prevent the formation of the often amorphous adherent substances, or to reduce the effect significantly,were not successful. Therefore, in the context of a research project supported by the Deutsche Bundesstiftung Umwelt (DBU, German Federal Environment Foundation), a new technique has been developed and tested which makes the RPC technology applicable for exhaust gases with deposit-forming components as well. The project partners are, besides CUTEC, the company LTB (Goldkronach) as a plant manufacturer and the company ALBIS (Hamburg) as a potential user.



Functional principle of the new technological approach

The innovative idea of this new technological approach, is to accept that the described silicon deposits occur, but to take out, clean and put back the ceramic regenerator material automatically at regular intervals (e.g. monthly). For this purpose, the conventional design with three regenerators has to be replaced by a modified system, in which the ceramic regenerator material consists of spheres that are located in a cylindrical container in the form of a single charge (figure upper right). The gas flows periodically through the bed top-down (downward flow) and then bottom-up (upward flow). Heat recycling is thereby possible by means of heat transfer from the exhaust gas to the pure gas. The silicon dioxide deposits form preferentially in the middle section of the bed (oxidation zone). For bed cleaning, a part of the fill is automatically taken out at the bottom and returned at the top after being purified.

The first phase of the project has been completed successfully with the set-up of the pilot plant and experiments on the development and optimization of a control strategy in Clausthal, and six months of test operation at ALBIS in Hamburg . In the project's second phase, approved by the DBU, the step of constructing the industrial-scale plant is now being tackled. For this purpose, additional pilot plant experiments are scheduled, among others with an oven coating (Miele) and in the field of barrel reconditioning (Bayern-Fass). These experiments will provide information about the behaviour of the plant at higher load. It can be concluded that the newly developed technology will be a safe alternative for the treatment of exhaust gases with silicon-organic compounds in the near future. (nee)

IMPRINT

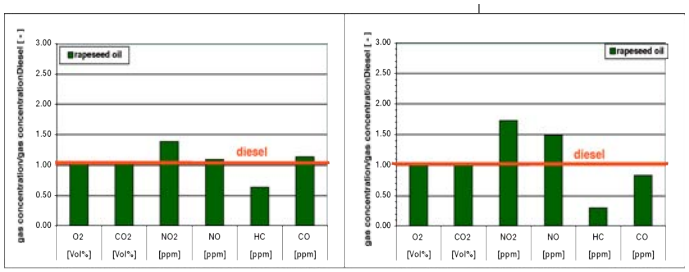
Publisher: CUTEC-Institut GmbH
Edithor: Dr. T. Heere
Authors:
Prof. Dr.-Ing. O. Carlowitz (ca)
Dr.-Ing. B. Benker (bk)
Dr. T. Heere (he)
Dr.-Ing. B. Kragert (kra)
Dipl.-Ing. O. Neese (nee)
Dr.-Ing. T. Onyeche (on)
apl. Prof. Dr.-Ing. M. Reuter (reu)
Dr.-Ing. O. Schläfer (schl)
Prof. Dr.-Ing. M. Sievers (siev)
W. Weber, B.A. (wb)
W. Wieczorek (wk)
Dipl.-Ing. A. Wollmann (wo)
Layout and setting: G. Wessels (wes)
Photos: Gert-E. Knochen (kn)
Production and supply:
CUTEC-Institut GmbH
Leibnizstr. 21+23
38678 Clausthal-Zellerfeld
Phone +49 5323 933-0
Fax +49 5323 933-100
E-Mail: cutec@cutec.de
Internet: www.cutec.de
Publication:
Several issues per year in irregular order.
The issues can be ordered at the a.m. supply address.

Pure rapeseed oil: From the field straight into the diesel engine?

It is frequently reported in the press how advantageous it is to run diesel vehicles on pure vegetable oil such as rapeseed oil. This is contrasted by other reports saying that vehicle manufacturers have not released their engines for operation on biodiesel, or have retracted the approval they had already given.

One reason for such contradictions is the inaccurate utilization of the term "biodiesel". In the narrower sense, it comprises all vegetable oils that have been chemically modified in such a way that they comply with the European standard EN 14214. The transformation – a so-called transesterification – primarily brings about the alteration of certain physical properties. Viscosity is reduced, the oil vaporizes more easily, and it ignites more easily in the engine. In its properties, rapeseed oil methyl ester (RME) is more similar to conventional diesel fuel than the unprocessed (purified) rapeseed oil. Therefore, the admixture of up to 5 % by volume of RME to conventional diesel is normally uncritical and contributes to the desired use of renewable resources.

Since the application of pure RME implies many problems which still need to be solved, one might fear that the raw product cannot be used in modern diesel engines at all. The challenge is great indeed, but several small and medium-sized companies have accepted it, and one of them – the company Eoil GmbH from Alfeld – has had emission measurements conducted on CUTEC's engine test stand.



Relative gas concentrations with stationary engine enterprise

The experiments are intended to provide orientation for further development, i.e. they are not concluding tests.

The company Eoil has developed a system that conditions the vegetable oils during engine operation in such a way that even the most up-to-date engines can be run on the alternative fuel. In the figure below, the system is illustrated schematically.

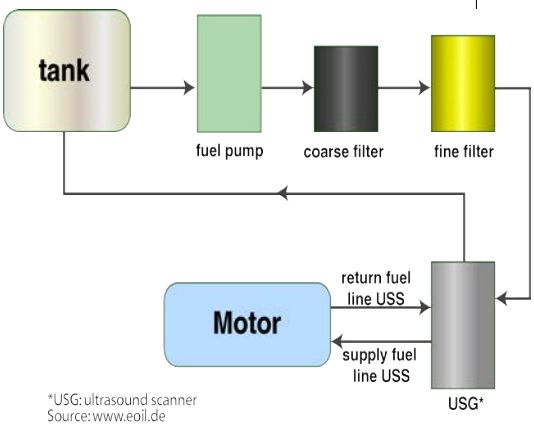


Diagram of the Eoil one-tank system

By means of a pump, the fuel is transported from the tank / storage container through a coarse and a fine filter into another container. In this container, the fuel from the tank is mixed with the fuel that runs back from the engine and which has a temperature of 80°C to 100°C, depending on the operating point.

In the context of this preliminary study, four points from the European urban driving cycle (EUDC) were selected at which the engine was in stationary operation mode. The measurements were conducted on a warmed-up engine. A switching device in the fuel pipe allows the engine to be operated alternately on rapeseed oil and on conventional diesel. The emission values of both fuels can thus be compared directly under otherwise identical conditions.

In the figure above, the gaseous emissions during operation on rapeseed oil are shown in comparison with diesel operation at two stationary points of medium and high load.

With increasing load, individual, limited emissions such as hydrocarbons (HC) turn out to be reduced during rapeseed oil operation compared to diesel operation. An increase in nitric oxides can be attributed, among other things, to the fact that the engine had not been optimized for vegetable oil operation.

It is clearly possible to operate a modern diesel car engine at important operation points – medium to high steady load – on pure vegetable oil in such a way that the CO_2-neutral, renewable resource also brings about a reduction of the legally limited exhaust emissions. The increased NO_x concentrations should be reduced either by means of the adaptation of the engine characteristics or by NO_x-reducing aftertreatment of the exhaust gas.

For CUTEC, such measurements are the entry point for intensive cooperation with innovative companies. Concluded measurements frequently provide the impulse for further important investigations; in this process, every success is "only" a partial success and highlights the direction to be taken for further steps of development. (wo/bk)

New: Ergonomic workplace

Almost everyone knows the problem: Sitting at a desk for hours is strenuous for the back and often leads to muscle tension. If someone already has a back complaint, desk work is even more likely to cause back pain. CUTEC has now taken this into consideration and has set up an ergonomic office workplace. Desk height is infinitely adjustable by means of an electric motor, so that it is possible to swap easily between a sitting and a standing position throughout the working day. Already after a few days, central purchasing officer Wolfgang Wieczorek was convinced: "The possibility to work at the desk in a sitting or standing position means an enormous relief for me. I was very pleased about the unbureaucratic installation of the ergonomic workplace". (wk)

Mr. Wieczorek at the new workplace

Waste management training for Nigerian delegation

The training course participants in front of the main entrance of CUTEC

In June 2006, a consulting contract between CUTEC and the central government of Nigeria was signed (see CUTEC News 2/2006). In order to integrate the local expertise into the development of a waste management system for the city of Abuja, the training of Nigerian engineers at CUTEC had been discussed as well. As a result, seven government employees took part in a training course in the field of waste management and landfill site development at CUTEC from 28th February to 14th March 2007. The Nigerian delegation comprised Mr. U. Agbanusi, head of the waste management department, Mrs. O. Olanipekun, responsible for environmental analyses, Mrs. D. Okenwe, hazardous waste sector, Engr. R. Usman, engineering, Mr. K. Imam, legal department, Mr. H. Dogon-Daji, waste disposal department, and Mr A. Yahaya, resource processing.

The main responsibility for course organization and realization was in the hands of the CUTEC manager of international operations, Dr.-Ing. T. Onyeche, and Dipl.-Ing. M. Struve, the managing director of the engineering office Prof. Hartung+ Partner, a close cooperation partner of CUTEC especially in Nigeria.

In the first part of the event, various lectures covered the topics of landfill site construction and soil protection, solid waste, mechanic and biological waste treatment, contaminated sites, environmental analyses and hazardous waste. The main focus was on comparing the waste situation in Germany and Nigeria.

In the second part, the electrical appliance and electronics processing plant Elektrocycling in Goslar, the DEUMU scrap metal processing plant in Salzgitter, the landfill site in Wolfenbüttel, the waste management centre in Braunschweig, and the lightweight packaging sorting plant of the ALBA Recycling GmbH in the vicinity of Berlin were visited. In addition, a visit to the Nigerian embassy in Berlin was scheduled.

At the end of the course, the participants agreed that they had received a detailed overview of the field of waste management and landfill site construction. At the same time, they had gathered important suggestions for the implementation of environmental measures in Nigeria.

(on/wb)

We congratulate …

apl. Prof. Dr.-Ing. Matthias Reuter

… apl. Prof. Dr.-Ing. Matthias Reuter on his appointment as a non-scheduled professor at Clausthal University of Technology.

apl. Prof. Reuter studied physics and geophysics at Clausthal University of Technology and completed his doctorate there in the field of physical chemistry. Subsequently, he was active as a scientific employee at the University of the Federal Armed Forces in Hamburg for several years. There he conducted research primarily in the field of pattern recognition by means of new statistical methods, neural networks and fuzzy logic. After that, apl. Prof. Reuter spent several years working as a scientist at the Institute of Process and Production Control Technology and at the University of Dortmund. In 2002, he obtained his postdoctoral qualification at Clausthal University of Technology. Since 2002, he has worked at CUTEC and directs the institute's Department of Modeling and Simulation.

His major research subjects are in the fields of "neural-based predictive control", "computing with activities" and the "application of innovative methods of data mining in simulation procedures".

Prof. Dr.-Ing. Michael Sievers

… Prof. Dr.-Ing. Michael Sievers on his appointment as an honorary professor at Clausthal University of Technology.

Prof. Sievers studied process engineering at Clausthal University of Technology and completed his doctorate there on the topic "Untersuchung komplexer Abwässer mit mehrstufigen Behandlungsverfahren" (Investigation of complex sewage by means of multistage treatment procedures).

Since 1990, he has been active at CUTEC, and he has successfully directed the Department of Physical and Biological Processes for more than ten years.

The major topics of his research are in the fields of waste water and sludge treatment as well as of energy generation using biological methods.

Mrs. Gerda Vollbrecht

… Mrs. Gerda Vollbrecht on her 75th birthday.

From 1990 up to the end of 2000, she was the "good spirit" of CUTEC. During this time, Mrs. Vollbrecht supported the managing directors and the members of staff as a competent and committed authorized clerk and business manager. With foresight, excellent expert knowledge and charm, she had a significant influence on the institute's fate. Even after going into well-deserved retirement in 2001, after 52 years of professional life, she has remained in faithful contact with "her CUTEC".

The CUTEC staff members wish Mrs. Gerda Vollbrecht health and good luck for the year ahead.

(he/wes)